**Lesson 3 – Genetics of Evolution (Kyle Barrett)**

**Overview** - Students will use their prior knowledge of genetics (from earlier lessons) to inform their perceptions of evolution. Cooperative groups will engage in peer learning, focusing on evolution in populations. The Hardy – Weinberg equation will be introduced and students will learn what it can reveal about allele frequencies in populations. The teacher will present a Power Point on loss of biodiversity and the increased risk of extinction events faced by monocultures. Students will be tasked to create a graphic organizer and write a short essay as homework.

**Standards –** Standards are those provided in the “Next Generation Science Standards”. Learning objectives based on standards specifically applicable to this lesson:

NGSS HS-LS3-1: Students will be able to contrast the range of potential genotypic variation within a population with the smaller range of successful phenotypes in a given environment.

NGSS HS-LS3-2: Students will be able to explain the three potential sources of inheritable genetic variation and summarize evidence that supports their explanations.

NGSS HS-LS3-3: Students will be able to analyze the frequency of an allele in a population and determine its proportions in subsequent generations.

**Materials / Preparation Checklist**

PowerPoint Presentation (teacher prepared)

Computer and projector for PowerPoint presentation

Whiteboard for additional explanations / descriptions (as needed)

Whiteboard markers

Note-taking Guide

Hardy – Weinberg worksheet

Essay rubric

Clown nose, wig, shoes

**Objectives**

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| Objective | How I will assess during lesson. | How I will assess after lesson. |
| Explain one aspect of population evolution to peer group | Observe small group preparations and discussions.  Monitor “report back” from peer experts. | Group members present one of their defined topics to the entire classroom. |
| Explain the concept behind the Hardy-Weinberg equation and use it correctly | Monitor students as they complete the Hardy-Weinberg worksheet (seatwork) | Students submit the Hardy-Weinberg worksheet for grading. |
| Explain how radical environmental damage, or limited biodiversity, can lead to mass extinction | Informal questioning during presentation | Students complete essay on mass extinction for grade. |
| Depict the differences and similarities between natural selection, genetic drift, and gene flow. |  | Students create a graphic organizer depicting the relationships and differences between natural selection, genetic drift, and gene flow. |

**Opening**

**HOOK:** Students will be greeted as they enter; the teacher will be wearing a clown wig, nose, and giant clown shoes. In order to activate prior knowledge on transmission of phenotypes to offspring, the students will be given a Punnett Square problem to solve in pairs. They must determine what proportion of the clown’s offspring will have each of the phenotypic characteristics, given the genotypes of the clown and his spouse. Students will conduct the analysis in their journals, and also be required to define “genotype”, “phenotype”, “gene”, and “DNA”.

Once they begin, “housekeeping” will occur, with attendance taken and any other administrative actions completed. Lesson 2 homework will be collected.

Upcoming Requirements: On the board will be a reminder that the Unit Assessment will occur during the 7th class meeting for this unit (a week from Thursday). Also, the board will convey that a lesson 3 worksheet will be due the following class period (Wednesday) and the lesson 3 essay will be due on Friday.

Day Goals: The “Key Take-Aways” will be listed on the board: Population Evolution; Hardy-Weinberg; Mass Extinction; Natural Selection; Genetic Drift; Gene Flow.

Transition: Students will report out what they have determined from their analysis. They will also provide definitions of the terms provided in the opening paragraph. The teacher will announce that the subject of today’s lesson is how heritable traits influence the evolution of populations.

**Instruction**

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| Instructional  Step | Teacher Actions/Questions (I will do/say...) | Student Actions/Instructions (Student will...) |
| 1 | Direct students to move into small groups of four and assign paragraphs to each member of a group. | Read content provided (text on evolution of populations) |
| 2 | Provide worksheets to each student for note taking. | Share three ideas about your topic with your group. Take notes of group members’ reports on worksheet. |
| 3 | Using whiteboard, explain Hardy – Weinberg to class. | Take notes |
| 4 | Demonstrate the solution to several separate scenarios | Take notes |
| 5 | Distribute Hardy – Weinberg worksheets | Complete worksheets independently. Answer accompanying questions. |
| 6 | Circulate among students during seatwork and respond to questions. | Submit Hardy – Weinberg worksheet upon completion |
| 7 | Provide PowerPoint presentation on biodiversity and extinction | Take notes |
| 8 | Provide students video link or CD-ROM with videos for review at home | View videos for homework; create a graphic organizer comparing and contrasting natural selection, genetic drift, and gene flow (due next class meeting). |
| 9 | Explain requirements for short essay (1-2 pages, double spaced, citations). Provide rubric. | Write essay. Due Friday (lesson five class day) |

**Accommodations**

Given the nature of the class this unit is designed for (advanced Biology), most students should be able to complete the math required by the Hardy – Weinberg exercise. However, ELL students would receive a pre-unit study guide with key vocabulary words (and associated images) designed to help them prepare for small group participation.

**Closing**

The teacher will quickly review the key terms and concepts for the day. Students will be reminded of the due dates for the day’s assignments and that the unit assessment will take place during the 7th class meeting for the unit (a week from Thursday).

**Notes / Resources**

This lesson plan is adapted from one created by Nicolle Wambold, Sierra Nevada College

<http://nicollewambold.wikispaces.com/file/view/Evolution+Unit+Plan.pdf/244787767/Evolution%20Unit%20Plan.pdf>

Appendix 3-1

Name:

Date:

Period:

**Evolution of Populations**

Record important ideas to remember about each of the following topics:

Genetic Variation Within Populations

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Genetic Variation Between Populations

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Mutation Types

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Sexual Reproduction

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Appendix 3-2

Name:

Date:

Period:

**Hardy-Weinberg Equation Worksheet**

Conditions of Hardy-Weinberg Equilibrium:

1.

2.

3.

4.

5.

1. There is one PKU occurrence per 10,000 births and the allele for PKU is recessive.

Determine the expected frequency of the heterozygous dominant genotype and the frequency of heterozygous carriers.

1. If all conditions of Hardy-Weinberg Equilibrium are met, and the figures you calculated above correlate with the actual population, then is the population evolving or not evolving?
2. If there is non-random mating, then what can we determine about the evolution of the population?

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|  | **Incomplete** **10 pts** | **Average** **15 pts** | **Exceptional** **20 pts** |
| **Introduction**  **10 %** | Incomplete  Does not state writer's position and plan for the essay and/or jumps right to the body of the essay | Average  Does state writer's position and plan for the essay, but is weak and leaves the reader confused about the topic and/or writer's position on the topic | Exceptional  States writer's position and plan for the essay clearly and strongly, so that the reader is not confused about the topic and/or position on the topic |
| **Supporting Evidence**  **40 %** Does writer avoid the use of emotional arguments? | Incomplete  Only one relevant, reliable, scientifically sound reference or makes use of many inflammatory statements, emotional arguments. | Average  At least two relevant, reliable, and scientifically sound references. Citation is used correctly most of the time. Emotional arguments are mostly avoided. | Exceptional  Three or more relevant, reliable, and scientifically sound references that adequately support the writer's position. Citation is used correctly. No emotional arguments. |
| **Appropriate tone**  **15 %** Writer writes in a professional manner. | Incomplete  Does not treat the subject seriously. Uses a lot of slang and informal language. Tone more appropriate for a letter to the editor of a magazine or newspaper than for a scientific paper. | Average  Some confused sentences; writer shifts person throughout essay or uses "you" and "I" frequently | Exceptional  Writer treats the subject seriously, using formal language. Position is clearly stated in an objective, logical manner. |
| **Conclusion**  **10 %** | Incomplete  No concluding paragraph - essay ends abruptly | Average  Weak concluding paragraph - does not summarize or restate the thesis clearly | Exceptional  Strong concluding paragraph - summarizes and restates the thesis in an interesting way that captures the reader's attention |
| **Organization**  **15 %** | Incomplete  Almost no organization; no logical progression of ideas; no use of transitions between paragraphs | Average  Some organization; some logical progression of ideas in some parts of essay, but not others; a few transitions, but not throughout the essay | Exceptional  Well organized; clear, logical progression of ideas; uses appropriate transitions |
| **Mechanics**  **10 %** | Incomplete  5 or more grammatical, punctuation, capitalization, and spelling errors | Average  4 or less grammatical, punctuation, capitalization, and spelling errors | Exceptional  no grammatical, punctuation, capitalization, and spelling errors |

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